Examiners' Report/
Principal Examiner Feedback

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Pearson Edexcel International A Level
In Core Mathematics C12 (WMA01/01)

Paper 01

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Core Mathematics C12 (WMA01)

General Introduction

Students found this paper, on the whole, accessible. Timing did not seen to be an issue with the vast majority finishing the paper. The quality of responses seen was high, showing that students had been well prepared by their teachers. Questions 8, 10, 13 and 16 were found to be the most challenging on the paper. A point that could be addressed in future exams is the lack of explanation given by some students in questions involving proof. (See questions 2(ii) 9(c) and 13(a))

Comments on Individual Questions:

Question 1

Part (a) was generally done correctly, with almost all candidates managing to demonstrate a correct use of the formula. There were, however, a few who gave $u_2 = (2 \times 2) - 6 = -2$ followed by $u_3 = (2 \times 3) - 6 = 0$.

Another mistake seen a few times was $u_2 = (2 \times 1) - 6 = -4$, sometimes followed by correct use of the recurrence relation to give $u_3 = (2 \times -4) - 6 = -14$.

Although the sum in part (b) was often calculated correctly, some candidates did not seem to understand the sigma notation, while others tried to use formulae for sums of arithmetic or geometric series.

Question 2

Although there were a large number of fully correct, often succinct, solutions, in part (i) work on indices was sometimes disappointing, and in part (ii) candidates often did not obey the instruction to "show all stages of your working".

Part (i): The expected method was to use the laws of indices to write $49/\sqrt{7}$ as a power of 7. It was surprising that this proved quite a challenge for some; even having reached the stage $7\sqrt{7}$ some candidates made no further progress or produced an incorrect value for a. Examiners were surprised to see the large number of candidates who used a logarithmic approach, but generally they were more successful than those that did not. Providing they correctly expressed a in terms of one of the log expressions in the mark scheme, they usually gained both marks, using their calculator, although a small number introduced inexact decimals and lost the final mark.

Part (ii): Most candidates were proficient with rationalising the denominator and multiplied numerator and denominator by $\sqrt{18} + 4$. This step needed to be seen clearly as it was easy to reach the required answer directly by use of a calculator. Candidates were required to show all stages of their work and so it was necessary to show, or imply by their work, that $\sqrt{18} = 3\sqrt{2}$ before the final step; many candidates completed their solution with $5\sqrt{18} + 20 = 15\sqrt{2} + 20$, which lost the final mark. Of those candidates who expanded $(15\sqrt{2} + 20)(\sqrt{18} - 4)$ [Way 2 in the mark scheme] to obtain 10, most lost the last mark as, although 10 = 10 was stated, no conclusion was given.

Question 3

This question was generally done very well with most candidates scoring at least 3 marks and many securing all 5 marks.

The most common error involved the integration of $\frac{2}{\sqrt{x}}$, which was sometimes incorrectly expressed in power form as $2x^{\frac{1}{2}}$. Some candidates who correctly integrated $\frac{2}{\sqrt{x}}$ then made a mistake in simplifying the coefficient, with $2 \div \left(\frac{1}{2}\right)$ sometimes becoming 1. A few candidates attempted to find a value for the unnecessary "+ c".

Substitution of the correct limits was occasionally followed by the loss of the minus sign from the second bracket when calculating$28 - (-4)$.

Some candidates integrated correctly but then forgot to substitute the limits. Other mistakes included substituting limits into the derivative of the expression or occasionally into the expression itself.

A significant amount of poor presentation was seen in this question, particularly the use of integral signs after integration had been completed.

Question 4

This straightforward arithmetic series question was answered successfully by the majority, about 90%, of candidates. The vast majority of candidates produced two correct equations and solved them simultaneously, but there were a variety of less formal methods employed: e.g. listing the terms using 3 as the fourth to get 3 - 3*d*, 3 - 2*d*, 3 - *d*, 3, 3 + *d*, 3 + 2*d*, equating the sum to 27, solving for *d* and then using 3 – 3*d* to find the first term of the series. Of the less successful candidates, most went on to score at least 3 marks; usually one equation was incorrect, e.g. Confusion with the 4th term equation, writing a + 2*d* = 3, or writing a + 5*d* = 27 instead of the equation for the sum of first six terms = 27. Most candidates showed their method for solving the equations simultaneously but some just wrote down their values for *a* and *d* with no working at all; these risked losing the last few marks, highlighting once again the importance of showing all working even in a relatively simple question. Only a few candidates used formulae for a geometric series.

Question 5

In part (a) most candidates were able to draw at least part of a sine curve, although some did not show at least one complete cycle or failed to draw it for the full range defined in the question. Completely correct responses were not common. The main errors were not labelling the axes at all, using degrees, or incorrect labelling. Sketches were sometimes very poor and occasionally the points from the table for part (b) were plotted.

Part (b) was accessible to most candidates with many fully correct responses, although there were a few attempts at "integration". Inevitably some used an incorrect value for h with $\pi/16$ and $1/12$ being the most common. Incorrect bracketing or calculator errors meant that some did not evaluate their expression correctly but their method was sufficient to earn 2 of the 3 marks.

Question 6

Although there were many excellent solutions to this question many candidates lost marks because they did not read the question carefully enough or used their calculator inappropriately.

Part (a): The question required the use of the factor theorem, so no marks were available for candidates using algebraic division. Of those using the correct method the vast majority showed that f(-3) = 0 but the final mark was frequently lost for not giving an acceptable conclusion.

Part (b): Finding the quadratic factor was usually successful; a range of methods were used, with an equal number of candidates using long division or inspection methods. Frequently the final mark was lost for failing to show the fully factorised expression $(x + 3)(x^2 – 2x – 6)$. Some believed that the roots were required and answered (c) in (b). Whilst the product of a linear and a quadratic factor was expected some solved and then gave the factorisation in the form $(x - 3)(x - 1 - \sqrt{7})(x – 1 + \sqrt{7})$.

Part(c): Although a large proportion of candidates used the quadratic formula, or completed the square, to successfully find the roots of the quadratic, marks were often lost for several reasons:

(i) $x = -3$ was omitted from the solutions, (ii) $x = 3$ instead of $x = -3$ was given, (iii) $x^2 – 2x – 6$ was wrongly factorised as $(x – 3)(x + 2)$, or similar, (iv) inexact roots (3.65 and -1.65) were given.

Some candidates, too, who had never found a quadratic factor, gave the three correct solutions, which had presumably come from solving the cubic equation f(x) = 0 on their calculator. This did not answer the request "Hence find the exact values ... of f(x) = 0"

Question 7

This was a straightforward question for many candidates and very few failed to attempt it.

In part (a) most earned at least the method mark with a variety of acceptable notations seen, such as $^8C_2$, $\binom{8}{2}$, (8x7)/2! A few candidates used Pascal's triangle.

Some candidates tried to "simplify" $1 + 8kx$ to, for example$9kx$.

Common mistakes were: bracketing errors, giving $28kx^2$ instead of $28(kx)^2$, omitting k altogether and failure to simplify the numerical coefficients.

In part (b) some candidates did not understand the meaning of "coefficient" and sometimes solved $x^3 = 1516$ in their attempt to find k. Some proceeded correctly to $k^3 = 27$ and then took the square root instead of cube root.

Question 8

Whilst many struggled with this question, they often were able to gain a few marks, but strong candidates often produced clear, concise, well-structured responses.

Part (a): Nearly all candidates recognised that they had to use tan x =sin x/cos x, although poor attempts at manipulation of the given equation often resulted in an answer of $\frac{7}{3}$ rather than the correct$\frac{3}{7}$. The follow through marks on the mark scheme meant that these candidates could still obtain 3 of the 6 marks available for this question.

Part (b): Many candidates established the connection between parts (a) and (b) and most were able to gain at least one the accuracy marks, but a common mark profile was B1M1A0A1A0.

Of those candidates who had a correct strategy, many did not go far enough with their values for

$2\theta + 30$ before finding θ and so omitted 1 or 2 answers, losing the final accuracy mark. Final solutions tended to be given to the required degree of accuracy and very few gave answers in radians rather than degrees.

Question 9

Most candidates showed sufficient evidence to earn the mark in part (a). The most common method was to use the common ratio 1.02 and calculate130000×1.02. A few used % notation, for example $130000 \times (1 + 2\%)$ to show the result.

Although most candidates gave the common ratio 1.02 in part (b), often having used it part (a), a popular wrong answer was 0.02 and a few candidates seemed unsure about what was required here. Although the wording of the question was "write down" (implying no working was needed), many candidates provided an explanation for their answer.

In part (c), there were many responses where it was clear that the candidate knew exactly how to tackle this question, but more often than not marks were lost. Sometimes brackets were missing from the$(N - 1)$, sometimes the inequality sign appeared only in the final answer and sometimes there was insufficient evidence of method, particularly in relation to the power law for logarithms. Candidates should be advised that when the "answer" is given every step of their method needs to be present to justify full marks. Many candidates preferred to take logs to base 1.02 and then to use change of base formula, which was an acceptable method. Some, however, used the sum of n terms rather than the nth term and were unable to gain any marks in this part.

A surprising number of candidates did not earn the mark in part (d). Many calculated correctly and wrote $n > 36$ or $n > 36.002$ but then gave $n = 36$ or in some cases $n = 35$.

Question 10

In this question the differentiation was invariably done extremely well; weaker candidates often gained these marks. The level of manipulation required in part (b) proved a challenge for many candidates, often highlighting a lack of confidence in working with indices.

Part(a): This part was done well.

Part(b): The processing of the equation when the derivative was equated to zero proved to be quite difficult, and of the first three marks available M1M0A0 was very common. The most successful attempts were when the first step was to have a term on both sides of the equation, but errors often occurred in raising the powers of both the coefficients and the variable. The least successful were when an attempt was made to take a power of x out of $15x^{1/4} - (5/9)x = 0$. A significant number of candidates who had correctly arrived at $x^{3/4} = 27$ could not correctly solve for x, with $x = 273/4$ being very common. Many forgot that they had been asked for coordinates and failed to find y, losing a further two marks. Once again the use of calculators often failed to demonstrate the skills necessary for full marks.

Part(c): A few candidates equated the second derivative to zero, rather than substituting their value for x. Those who successfully calculated $d^2y/dx^2 = -5/12$, oe, often failed to state that it is because it is negative that the point is a maximum, hence losing the final mark. A significant number of candidates did not calculate the value of the second derivative but just stated that it was negative and therefore did not qualify for the final two marks.

Question 11

The majority of candidates were able to tackle part (a) this part of the question very successfully. However, a significant number were only able to score the initial M mark due to a lack of algebraic ability to manipulate the expression and make $\cos(YXZ)$ the subject. A small number of candidates found a different angle from the one asked for and proceeded to use this as angle YXZ in the remainder of the question. Some lost the minus sign and worked with the acute angle 1.52 throughout the question. Candidates sometimes lacked confidence in using radians, preferring to work in degrees and subsequently convert. Those who converted their angle from degrees to radians often lost accuracy from this early stage.

Although part (b) was tackled very successfully by most candidates, a surprising number failed to understand how to find the required perimeter. Most were able to successfully use $r\theta$ to find the arc length but this was sometimes followed by $38 - 18.1$ as candidates took away the sector perimeter from the triangle perimeter. Another common mistake was to assume that AY and BZ were equal, giving$5 + 5 + 16 + 8.1$. Again working in degrees was popular.

Part (c) This part was very well done and candidates who knew the formulae well were able to proceed with little difficulty. Mistakes were usually due to a wrong formula or to the assumption that the perpendicular from X bisected the base of the triangle. Some candidates lost the final mark due to rounding errors, getting 39.6 instead of 39.7.

Question 12

Part (a): There were many good solutions but success depended to a large degree on the ability to Expand $(4 + 3\sqrt{x})^2$. It was a little disappointing to see, at this level, errors such $16 + 9x$, $16 + 24x + 3x$, $16 + 24\sqrt{x} + 9\sqrt{x}$, which proved very costly. Having divided their result by x, some Candidates made errors in converting it to the required index form.

Part(b): Most candidates who had an expression of the required form, as given on the question paper, went on to differentiate their f(x) correctly, coping well with the negative and fractional powers. However, there was a significant minority of candidates who seemed to be unfamiliar with the notation f '(x).

Part(c): Most candidates were able to substitute $x = 4$ into f(x) to find the corresponding y value, and, if they had found the correct gradient at $x = 4$, went on to score well. Some candidates incorrectly used the negative reciprocal for the gradient giving the equation of the normal instead of tangent, and could only gain 2 marks. Although the equation was not required in any specific form, it was interesting to note that most candidates left it in the form $y = - 2.5x + 35$. If the equation was left as $(y – 25)/(x – 4) = -5/2$ this was insufficient to gain the last A mark, as it is undefined for $x = 4$.

Question 13

Many candidates found this question difficult, particularly part (a). Some did not seem to have any idea how to start this and, of those who did, a surprising number made sign errors in rearranging the given equation. There were many other basic algebraic errors, such as $9k – 2$ becoming $7k$. It was widely known that the discriminant $b^2 - 4ac$ needed to be used but some candidates had difficulty in identifying a, b and c. Some began with $b^2 - 4ac > 0$ instead of $b^2 - 4ac < 0$.

In part (b) most candidates were able to find the correct critical values -3/11 and 3, by factorisation or formula but some stopped at that point and others were unable to identify the correct "regions", with the wrong answers $-\frac{3}{11} < k < 3$ and $k > -\frac{3}{11}, k > 3$ being common. In general, however, candidates had more success with part (b) than with part (a).

Question 14

This question showed a lot of variation in responses. Although some candidates answered both parts of the question well, a significant number were only able to offer meaningful attempts in only one part. A small minority of candidates were not in control of the theory of logarithms and gained no marks.

Part(i): Most responses used at least one law of logarithms correctly to obtain the first method mark. There were some common errors, such as treating $\log_a 27$ -1 as $\log_a 26$, and misuse of the laws of logs, e.g. writing $\frac{\log(3x)}{\log 27}$ = -1. In the latter case, although further errors often produced the correct result, recovery was not condoned and a maximum of one mark was scored. Sign slips and errors in rearrangement led to answers such as $x = 9a$, but the most common reasons for losing the final accuracy mark was leaving the result un-simplified as $x = 27/3a$, and a surprising number failed to make x the subject.

Part (ii): The majority of candidates who recognised the disguised quadratic equation solved it efficiently, usually making a substitution of $x = \log_5 y$ to find y. Occasionally $x = 3$ and $x = 4$ were found but not y, but most candidates were well able to use powers correctly to obtain a value of y from the equation $x = \log_5 y$. The most common mistake in this part of the question was to treat $(\log_5 y)^2$ as $2 \log_5 y$ and these attempts gained no marks.

Question 15

This question appeared to distinguish between those who understood the geometry of the circle, and only lost marks due to careless errors, and those who had very little idea of what they were doing. It did seem that some candidates would have benefited by a clear, or clearer, diagram as some coordinates were used inappropriately.

Part (a): It was common for candidates to begin by finding the distance between A and B. Many candidates then identified the radius, found the midpoint and produced a valid equation for the circle. Mistakes were made in calculating r or r^2, with many not realising they had actually found the diameter. The mid-point, when found, was usually correct, with only a few candidates using a wrong formula. It was surprising to see A or B used as the centre of the circle rather than the midpoint of AB. Most candidates were familiar with the general form for the equation of a circle and a few attempted to expand and simplify their equation, usually successfully.

Part (b): The first method mark was the key to success in this part. A very large number of candidates failed to realise that the gradient of the line from their centre to (4, 8) was the first calculation required; many calculated other gradients, usually that of the line AB, which meant only one mark was available for this part. All but the weakest candidates picked up at that mark, for finding the negative reciprocal of their gradient. Most candidates used the straight line formula

$y - y_1 = m(x - x_1)$ although the use of $y = mx + c$ remains a popular method. There were a few cases where implicit differentiation of the circle equation was used to find the gradient at (4, 8) and these usually went on to score well. Most candidates attempted to put the equation in the required form, often with integer values for a, b and c, although that was not necessary. Some lost the final mark due to arithmetical errors, or failing to put their expression equal to zero.

Question 16

Part (a) was answered very well with nearly all candidates forming a correct equation and the vast majority solving the equation correctly to find the correct points of intersection. Some candidates failed to find the y coordinates or gave $y = 0$. A few incorrectly rearranged the equation $\frac{1}{2}x + 1 = x^2 - 4x + 3$ (the equation $x^2 - 3.5x + 3 = 0$ was sometimes seen).

It was unusual for candidates not to score both marks in part (b).

Responses to part (c) were very mixed. Most candidates scored some marks here and there were a good number of fully correct solutions. Some, however, missed out this part.

Many candidates adopted the approach of integrating the equation of the curve and attempting the area of the trapezium. This approach was the one that was often done most successfully. However, candidates following this approach often just integrated the curve between the limits $x = 0.5$ and $x = 4$ (or sometimes just between the limits $x = 1$ and $x = 3$). Occasionally the formula for the area of a trapezium was applied incorrectly.

Other candidates adopted the (line – curve) approach. Deciding on the correct limits caused the most errors again here. A common mistake was to think that the required area could be found solely by evaluating $\int_{0.5}^{4} \left((0.5x+1)-(x^2-4x+3)\right)\,\mathrm{d}x$ or $\int_{1}^{3} \left((0.5x+1)-(x^2-4x+3)\right)\,\mathrm{d}x$.

Some candidates using this approach integrated the quadratic they derived in part (a), which was sometimes $2x^2 - 9x + 4$.

Some candidates who found all the required integrals then combined them incorrectly. A few lost the final mark because they gave the answer in a rounded form rather than as an exact value. Other errors that were sometimes seen included using y-coordinates as limits instead of x-coordinates.

Candidates should be aware that they need to show the integrated function and not merely produce a numerical value for a definite integral straight from a calculator.

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